Column 439

Changing treelines in a warmer world

by Sarah Locke

"A great expanse of high barren country lay before us with hardly a tree in sight. In the distance it appeared to be quite smooth."

When trophy hunter G.O. Young travelled across the Burwash Uplands more than 80 years ago, he and his party were exposed to the blast of the elements on this sweep of tundra. Today he would be able to take shelter among trees, as young white spruce are scattered across this plateau.

Ryan Danby, a PhD student at the University of Alberta, has been studying treeline in the Kluane area for the past five summers. He has found that treeline has advanced nearly 100 metres in elevation on south-facing slopes during the last century.

While young white spruce now grow on the Burwash Uplands, this plateau was covered by tundra a century ago.

(photo: Ryan Danby)

"But it has not been a gradual change; it has been episodic, a rapid upslope jump," he says. "On the plateau, most of the trees established themselves between 1925 and 1945."

Danby does not have the data to say exactly why treeline already has changed so rapidly in the Burwash Uplands. In addition to warming caused by human activities, the trees could have established themselves during a time when the climate was still rebounding from colder temperatures that prevailed during the Little Ice Age of the mid-nineteenth century.

But he has little doubt that climate change will influence treeline in the North, as temperature seems to be the main factor controlling where trees can and cannot grow. Most researchers predict that climate change will lead to trees growing both at higher elevations and farther north.

Danby says the Kluane area allows him to study both the abrupt transition from the subalpine forest to the tundra on steep mountain slopes, as well as the more gradual

change found on some of the gently sloping plateaus where trees give way slowly to tundra as they do in arctic regions.

"The arctic and the alpine treelines tend to get lumped together, but the scale of an individual tree is much more prominent at an alpine treeline than with an arctic one. The transition is more abrupt in the alpine," he says.

However temperature is not the only factor that influences the location of treeline. For example in the Burwash Uplands, the elevation of treeline on north-facing slopes has not changed.

"The north-facing slopes are underlain by permafrost so there might not have been enough of a warming to thaw the permafrost," he says.

The amount of sunshine a slope receives heavily influences treeline as well. On south-facing slopes the treeline is 100 to 150 metres higher in elevation than on north-facing ones.

To tease out these different elements, he has been coring trees, erecting miniature greenhouses, and analyzing satellite images and aerial photos. Cores taken from about 800 spruce and 1,000 willows will help show where treeline was in the past.

He hopes that data from a variety of sources -- including tree rings, lake core sediments and ice cores from Mt. Logan -- will establish what past climates were like.

To simulate what the future could bring, he fashioned miniature greenhouses by cutting the tops off of Plexiglas cones and planting them on top of 40 spruce seedlings, while another 40 seedlings grew out in the open as controls.

Ryan Danby collects data from one of the seedlings in his study of treeline in the Kluane area.
(photo: Ernest Hollonquist)

The temperature under the cones was about three degrees warmer than outside. Climate models predict that temperatures in the southwest Yukon could warm by this amount within less than a century if carbon dioxide levels continue to rise at a steady rate.

"We just took the cones down this year and 'lo and behold,' warmer temperatures inside the cones made those seedlings grow faster," he says.

"We found that getting established does not seem to be the limiting factor for a tree, or for the advance of treeline. The limiting factor seems to be the ability to grow from

a little guy to a tree," he says.

Danby has finished his research and hopes that his data will help forecast how treeline could change in a warmer world. He has already helped develop a basic model showing possible changes, but wants to build a more sophisticated one that can factor in variables like slope and exposure.

"What we want to do is take all of this information and use it to construct a model of future landscape change," he says. "Some of the results could be used in protected area and wildlands management to help forecast trends; not necessarily to make predictions, but we can give trends."

For example, he points out that moose could benefit from advances in treeline as they would have more habitat available for the fall rut, which takes place in the subalpine zone below treeline. But Dall sheep would lose habitat under this same scenario.

"Ultimately where this goes is to predict habitat change and how it will affect wildlife and people who live on the land and depend on that wildlife," he says.

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